

## REMARKS

This paper is in response to the official action of July 12, 2005. Reconsideration of the application, as amended, is solicited. This paper is timely filed as it is accompanied by a petition for automatic extension of time to file in the second month and the requisite fee.

The examiner's allowance of claims 1-3, 35-37 and 65 is noted with appreciation.

The issues raised by the examiner will be addressed in the order in which they appear in the action.

### Objection to the Specification and Drawings

The examiner has objected to the specification and drawings, and has requested the applicant to match all references in the specification with references in the drawing figures.

With respect is not understood, as no errors have been identified by the examiner.

### Claim Rejections - 35 U.S.C. § 113

The examiner has rejected claims 4-7 under 35 U.S.C. §103(a) over previously cited Rezanka in view of newly cited Williams. This rejection is respectfully traversed.

The rejected claims have been amended to clarify the distinction over the cited art.

The examiner has cited Williams in support of the assertion that piezoelectric and thermal technologies can serve as equivalent replacements for each other.

A printer operating with thermal print technology may be an equivalent replacement for a printer operating with piezoelectric technology. It may also be the case that in a generic printer design, a thermal printhead may be a functional equivalent for a piezoelectric printhead. It is not the case, however, that **within the design of a printhead** a thermal actuation element is functionally equivalent to a piezoelectric actuation element. The modes of actuation are fundamentally different and there are design considerations and constraints that are unique to thermal technology and *vice versa*.

It is accordingly necessary to exercise care when looking at a disclosure relating to a different technology (thermal or piezoelectric), to determine whether a skilled artisan would apply the teaching.

In the present case, Rezanka clearly and consistently refers to a problem arising only with thermal technology. There is no motivation to apply the teaching of Rezanka to piezoelectric technology because the problem discussed in Rezanka is generally not encountered with piezoelectric technology.

The examiner has alleged that motivation for the skilled artisan would lie in the supposed benefit of producing sharper images. This is not a relevant motivation. Depending upon the application, a skilled artisan may choose thermal or piezoelectric technology. Having made that selection, he would turn to Rezanka if thermal technology was selected and would not turn to Rezanka if piezoelectric technology were selected. Rezanka clearly and consistently refers to thermal technology and as noted, specifically addresses a problem described only in relation to thermal technology. A general equivalence at a high level between thermal printing technology and piezoelectric printing technology is, with respect, not sufficient motivation under §103 to cause one skilled in the art to depart from the clear and consistent teaching of Rezanka.

Further, Rezanka discloses a number of embodiments which share the characteristic of an ink flow path (from an inlet manifold and past a heating resistor in the vicinity of an ejection orifice) of uniform cross-section and free from obstruction. Because of the nature of thermal actuation, it is not difficult for one skilled in the art to envisage a free flow of ink passing the heating resistor with a droplet of ink being effected substantially instantaneously upon application of a heating current. The formation of a bubble in the ink adjacent the orifice operates in a simple manner to effect droplet ejection.

If the heating resistor of Rezanka were replaced by a piezoelectric actuator which simply changed the volume of the fluid passageway, the effect would not be to eject a droplet. Conventional piezoelectric actuators operate with movement in one sense to draw ink into a chamber and with movement in the opposite sense to eject a droplet from the chamber. If the fluid connection between the chamber and the ink supply is unimpeded (as it is in Rezanka), the skilled artisan would recognize that the piezoelectric reduction in volume in the actuator would simply return ink to the ink supply rather than eject a droplet. Thus, the free and open passageway which is established in Rezanka for the purpose of a continuous flow of ink renders the desire inherently unsuitable for piezoelectric actuation, which relies upon the path of the fluid supply having a sufficient impedance to ensure that a drop is correctly ejected.

Accordingly, a skilled artisan having the conventional view of piezoelectric actuation would find the design of Rezanka unsuited for piezoelectric actuation, even if it were assumed that he had the motivation to attempt the combination.

The present inventors have come to two realizations which are entirely unexpected and which would not have been in the mind of one skilled in the art viewing Rezanka and/or Williams at the priority date of the present invention.

The first realization is that the reliability of a piezoelectric printhead can be substantially improved by arranging for a flow through the fluid chamber simultaneously with any droplet ejection. It was found by the present inventors that the continuous flow (if it is large enough) acts to entrain foreign bodies (such as air bubbles) that would otherwise enter and block the orifice. This is quite separate from the problem peculiar to thermal technology which is addressed in Rezanka.

The second realization is that it would be possible to employ piezoelectric actuation even where a fluid chamber had a completely open connection with a fluid supply, enabling a

continuous flow of fluid through the chamber. This, according to the present inventors, can be achieved by arranging for the piezoelectric actuator to establish an acoustic wave, in the chamber as set forth in the specification and in the documents it refers to. It is only in this way that the inventors were able to reconcile a seemingly contradictory requirement of a continuous and large flow through the chamber with the selective ejection of droplets from the chamber.

This feature of the invention is brought forth more clearly in the amended claims.

For the foregoing reasons, it is urged that all pending claim 1-7, 35-37, and 65 are in proper form and of proper scope for allowance, and such action is solicited.

Should the examiner wish to discuss the foregoing or any matter of form in an effort to advance this application toward allowance, he is urged to telephone the undersigned at the indicated number.

Respectfully submitted,

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